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REVIEW: ROLE OF SYRPHIDS (DIPTERA: SYRPHIDAE) AS BIOTIC AGENTS AND POLLINATORS IN PAKISTAN

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ABSTRACT

The agriculture sector is important in the overall economy of Pakistan. There are many limiting factors in crop production. The two important factors are pest damage and pollination in addition to many others. Pest damage remained a serious problem since the dawn of human civilization. With the advancement of knowledge regarding safety of environment, pests are now tackled through Integrated Pest Management (IPM) techniques. In IPM, biological control through use of natural enemies is quite significant and the favored approach. Pollination is an essential ecosystem service. Effective pollination results in increased crop production, quality improvement and more seed production. One of the important groups of pollinators is Syrphid. About 84 species are reported from Pakistan. However, they have not been practically and effectively applied in both IPM and pollination contexts.

Key words: Syrphids, biocontrol, pollination, Pakistan.

INTRODUCTION

Food security is of strategic significance for a country. The prosperity and welfare of a nation lies on this. The Agriculture sector is the major contributor in the overall economy of Pakistan. There are many limiting factors in crop production. The two most important factors are pest damage and pollination. Pest damage remained a serious problem since the dawn of human civilization. Pests include insects, diseases, weeds and vertebrates. These had been mostly dealt with by using pesticides. With the advancement of knowledge regarding the safety of the

environment, pests are now tackled through Integrated Pest Managemnt (IPM) techniques. In IPM, biological control through use of natural enemies is quite significant and the favored approach. It has been successful in some crops and the environment. In Pakistan, this has resulted in the popularity of this system.

Pollination is important for crop production in Pakistan, as it is elsewhere (Irshad and Stephen, 2014). Pollination is the transfer of pollen from one flower to another and is critical to fruit and seed production. Many fruits, vegetables, edible oil crops, stimulant crops and nuts are highly dependent on pollination. Worldwide value of pollinators is €153 billion (217 billion US dollars) (Gallai *et al.*, 2008). The production value of pollinated dependent crops in Pakistan is 1.59 billion US$. Of the total value, fruits are dominant with 0.98 billion, vegetables 0.32 billion, nuts 0.15 billion, oilseed 0.13 billion and spices 0.004 billion US $ (Irshad and Stephen, 2013). The majority of the pollinator fauna of Pakistan is comprised of insects belonging to the orders hymenoptera and diptera. Hymenoptera is one of the largest orders of insects. Some other pollinators belong to Lepidoptera and Coleoptera. In diptera Syrphids are important agents. The syrphid fauna of Pakistan was not consolidated until Irshad (2003) and Irshad and Khan (2005) compiled the list of syrphids of Pakistan. Later on it was expanded and modified (Irshad *et al.*, 2013; Irshad and Stephen, 2013a). This list was further modified and published (Ghoprade and Shezad, 2013).

General Biology and Biological Control

Adult females emerge with an undeveloped reproductive system and require a protein source to mature eggs. The principal food of adult syrphids is pollen and nectar. Mating often takes place on the wing. Some species form male swarms. The fecundity is between 500 to 1,500. The white eggs are generally laid singly on the underside of the leaves. The eggs are laid in small groups in a row. The duration of the egg stage is about 5 days. The larvae are active between dusk and dawn. They have sucking mouthparts. Prey consumption rate in the laboratory varies from 135 aphids to 550. Larval development can be completed in 10 days but more frequently extends to about 40 days. Some species pupate on the foliage near the feeding site, while others leave the plant and enter the soil to pupate. There may be five to seven generations per year. The majority of the syrphids are multivoltine and over winter as final instar larvae, pupae or adults. Syrphids have occasionally been used in classical biological control. The adults need flowers as nectar and pollen sources. They are

attracted to weedy borders or mixed garden plantings that are infested with aphids.

Important Species

The important species of syrphids are given below.

Ceria dimidiatipennis Brunetti. It has been collected from Abbottabad, Kashmir, Hangue, Quetta, Swat. It is quite abundant in the country.

Episyrphus balteatus DeGeer**.** It has been reported from Abbottabad, Batrasi, Charsadda, Dargai, Dir, Faisalabad, Ghari Habibullah, Ghora Gali, Hangu, Jehlum, Kharan, Kohat, Lahore, Makran, Mardan, Murree, Multan, Mungawal, Nowshera, Parachinar, Paras, Peshawar, Rawalpindi, Sialkot, Swat, Tall, Tando Jam, Timurgarh and Wah. Thus it is widely distributed in the country. Its hosts include *Erisoma lanigerum* (Hsm.) (Aphididae: Hemiptera) *Adelge*s *joshii* s.o.s. (Adelgidae: Hemiptera). It is quite abundant species. The duration of egg, larval, pupal stage and total development period is 2-3, 15-19, 13-15 and 30-37 days, respectively. Eggs are observed in last week of February and grubs can be seen feeding on the food in March. Both adults and grubs can be seen in April-July. It appears to be multivoltine. It can consume 393-1005 aphids in 16-20 days of larval time. The developmental period is the lowest of 16 days when fed on *Sitobion avenae* (F.) as against 19 days on *Myzus obtusirrostris* David and *Shizaphis graminum* (Rondani). The mean consumption during the development varies markedly, the lowest being 392 of *Rhopalosiphum maidis* (Fitch.) as against 1,058 of *M. obtustiostris* (CIBC, 1976).

Eristalis tenax Linnaeus. It has been reported from Ghora Gali, Lahore, Murree; Multan, Mungawal, Peshawar, Sibi, Ziarat. It is also widely distributed and is fairly abundant in the country.

Eristalinus laetus Wiederman. These are found in Multan, Panjur, Peshawar, Quetta, and Ziarat, and are the most abundant species in Multan.

Eristalinus taeniops Wied. It was collected from Jhang, Multan, Pishin, Quetta.

Eupeodes corollae Fab. It is reported from Faisalabad, Ghora Gali, Lahore, Multan, Mungawal, Murree, Parachinar, and Peshawar. Its hosts are *Melanspis sacchari* Zehn., *Rhopalosiphom maidis* Fitch., *S. graminum* (Aphididae: Hemipetra). Its female to male ratio is 1:0.75. Each female lays 143-232 eggs. Development averages 3 days for egg stage, 7 days for larval, 1 day for pre-pupal, 7 days for pupal and 5 days for adult stage. Up to 400

aphids are consumed by the larval stage with 90 % consumption by 3rd instar. It can reduce aphid population by 74 % when the predator to prey ratio is 1:80 at the infestation level of 500-600 aphids per plant (CIBC, 1976). It is quite an abundant species.

Ischiodon scutellaris Fabracius It is distributed in Ghora Gali, Murree, Multan, and Mungawal. It is the second most abundant species in Multan (Sajjad and Saeed, 2010).

Paragus. indicus Brun. It has been collected from Balakot, Faisalabad, Murree, Parachinar, Peshawar, Swat, and Timurgarh. It preys upon *M. sacchari*, *M. obtusirostris , R. maidis, S. graminum* (Aphididae: Hemiptera). It is quite abundant.

Paragus serratus Fabracius. It is reported from Butkhela, Dir. Faisalabad, Karachi, Malakand, Multan, Parachinar, Peshawar, and Swat. It preys upon *M. sacchari, Myzus obtusirostris* David, *R. maidis, S. graminum* (Aphididae: Hemiptera).

Scaeva. pyrastri Lin. It has been collected from Abbottabad, Chitral, Dargi, Hangu, Kohat, Lahore, Murree, Parachinar, Paras, Peshawar, Rawalpindi, Timurgarh, Swat, Thall and Wah. Its food consists of *Aphis gossypii* (Glov.), *Lipaphis pseudobrassicae* (Davis), *Myzus persicae* (Sulz.) (Aphididae: Hemiptera). Each female can lay 235 eggs with hatching of 65%. Heavy infested plants with aphids are preferred. Aphid population is reduced by 84% after 25 days of release.

Syrphus confrator Wiederman. It is reported from Galiat, Lahore, Murree. It preys upon *A. joshii* (Adelgidae: Hem.), *E. lanigerum* (Aphididae:Hem.). Its incubation period is 2-3 days at 20^{o}C, larval period is 11-20 days, pre pupal period is less than a day, and pupal period is 8-15 days. Its adults become active in the last week of April. The grubs are common in March. Both larvae and pupae are found in April. The species seems to be multivoltine with overlapping generations.

Pollination Ability

Many Rosaceous flowers are visited and at least partly pollinated by syrphidae. The fruit plants include apple, pear, strawberries cherries, plums, apricot and peach. They also pollinate tropical fruits such as mango and *Piper, and* visit a number of spices and vegetable plants of the family Apiaceae like fennel, coriander, onions, and carrots.

The syrphids collected from various crops in Pakistan during the flowering period possibly pollinating them are given below.

Apple: *Eristalis tenax* Linnaeus, *Eristalinus arvorum* Fabricius, *Episyrphus balteatus* DeGeer, *Eupeodes corollae* Fabricius, *Ischiodon scutellaris* Fabricius (Shezad, 2011).

Bitter gourd: *Eristalinus aeneus (*Scopli) (Saeed *et al.*, 2012.).

Litchi: *Eristalis arvorum, Eristalis solitus* Walker, *Episyrphus balteatus*, *Eupeodes confrater* Wied., *Eupeodes corollae, Sphaerophoria indiana* Bigot, *Ischiodon scutellaris, Melanostoma orientale* Weid., (Ali *et al.*, 2013).

Mango: *Eristalis tenax*, *Eristalinus arvorum, Episyrphus balteatus*, *Eupeodes corollae*, *Ischiodon scutellaris* (Shezad, 2011).

Onion: *Episyrphus balteatus*, .*Eristalinus aeneus* (Scopli), *Eupeodes corolla, Eristalinus arvoru*m (Fabracius) *Lathyrophthalmus quadristriatus* (Macquart). , *Mesembrius bengalensis* (Wieid.) (Saeed *et al.*, 2008; Sajjad *et al*., 2008).

Toria and Sarson: *Eristalis tenax*, *Eristalodes taeniops* (Wied.), *Eristalinus aeneus (*Scopli), *Ischiodon scutellaris, Scaeva albmacaculata* (Macquart), *Sphaerophoria indiana* Bigot (Rahman, 1942).

Alfa Alfa :*Cerioides* sp., *Episyrphus* sp., *Eristalis* sp., *Scaena* sp., *Syritta* sp., *Syrphus* sp (Ahmad, 1976).

In Multan, a total of 51 species of flowering plants in 28 families were observed for the syrphid fly. Of the recorded plant species, 11 were agricultural crops and the remaining 40 plant species were wild plants, shrubs or trees. Among the syrphids, 5 species belonged to the genus *Eristalinus* (*E. aeneus*, *E. laetus*, *E. taeniops*, *E. arvorum* and *E. quadristriatus*), and others like, *Episyrphus balteatus*, *Syritta pippins, Ischiodon scutellari*s, *Eristalis tenax, Melanostoma* sp., *Sphaerophoria bengalensis, Scaeva latimaculata*, *Eupeodes corollae, Paragus serratus* and *Mesembrius bengalensis* were single in their genera. The most abundant syrphid species included *E. aeneus*, followed by *I. scutellaris* and *E. balteatus* (Sajjad and Saeed, 2010). According to Sajjad *et al.*, 2010 mango flowers were visited by maximum number of syrphid species. An abundance of hoverflies was correlated with floral abundance.

CONCLUSION

The injury by pests sometimes may be so severe that economic yield of a crop may not be possible. In many cases, economic returns have only been possible by chemical control in addition to some

other inputs. The most widely practiced method, the chemical control is now often widely criticized for its ill effects, and especially for disturbing the ecological system/balance. Irshad (2008) described the importance of Syrphidae as biotic predatory insects.

There are various reason of pollination deficit such as loss, destruction and degradation of habitats excessive tillage, destruction of trees, extensive weeding, deforestation, reduced genetic diversity of nectar plants, pests and pathogens, climate change, extensive and intensive use of pesticides especially insecticides and herbicides. All these factors individually or in combination are causing the deficit. Hoverflies are important pollinators of flowering plants in a variety of ecosystems in Pakistan. About 6,000 species in 200 genera have been described in rhe world. There are more than 84 species of syrphid flies in Pakistan. They are often seen hovering at flowers. The adults of many species feed mainly on nectar and pollen. They are second most important group of pollinators after wild bees. Although hoverflies are often considered to be mainly non-selective pollinators some hoverflies species are highly selective and carry pollen from one plant species. Specific flower preferences differ between species, but syrphid fly species have repeatedly been shown to prefer white and yellow coloured flowers.

Sometimes, bee-pollinated open flowers produced fewer seeds per plant than those pollinated by syrphids. Fruit production increased with pollinator diversity.

Syrphid flies can be as abundant as bees at flowers or even more so. Although not as proficient as bees at pollinating flowers, they do a fair amount of transporting pollen from blossom to blossom. In fact, some small flowers, flat, open, easy to reach, can be pollinated entirely by these little flies if there are no bees around. Syrphid flies may pollinate some crops almost as efficiently as bees do. The individual flies may not be very efficient, but if they are abundant enough they make up in numbers what they lack in skill. Hoverflies require approximately five-fold densities of the red mason bees to reach a similar fruit set and yield. The natural pollinator taxa, however, are of potential value in open and closed crop production systems. Each insect visitor has its own pollination effectiveness, depending on behavioural characteristics like flower constancy, foraging speed, pollen load on the body, and pollen deposition.

Episyrphus balteatus is a quite widespread species in Pakistan with better biotic potential. It has

been well studied, therefore this species could be a good candidate for biological control and pollination. It can be conserved with recommended methods. Moreover its mass rearing should be attempted.

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